

SCIENCE AND ENGINEERING INDICATORS 2000

VOLUME 1



National
Science
Foundation

NSB

NATIONAL SCIENCE BOARD

National Science Board

- DR. EAMON M. KELLY**
(Chairman), President Emeritus and Professor,
Payson Center for International Development &
Technology Transfer, Tulane University
- DR. DIANA S. NATALICIO**
(Vice Chair), President, The University of Texas,
El Paso
- DR. JOHN A. ARMSTRONG**
IBM Vice President for Science & Technology
(Retired)
- DR. PAMELA A. FERGUSON**
Professor of Mathematics, Grinnell College
- DR. MARY K. GAILLARD**
Professor of Physics, University of California,
Berkeley
- DR. SANFORD D. GREENBERG**
Chairman & CEO of TEI Industries, Inc.,
Washington, DC
- DR. M.R.C. GREENWOOD**
Chancellor, University of California, Santa Cruz
- DR. STANLEY V. JASKOLSKI**
Vice President, Eaton Corporation, Cleveland, OH
- DR. ANITA K. JONES**
University Professor, Department of Computer
Science, University of Virginia
- DR. GEORGE M. LANGFORD**
Professor, Department of Biological Sciences,
Dartmouth College
- DR. JANE LUBCHENCO**
Wayne and Gladys Valley Professor of Marine
Biology and
Distinguished Professor of Zoology, Oregon State
University
- DR. EVE L. MENGER**
Director, Characterization Science and Services,
Corning Inc. (Retired)
- DR. JOSEPH A. MILLER, JR.**
Senior Vice President for R&D and Chief Technology
Officer, E.I. du Pont de Nemours & Company,
Wilmington, DE
- DR. CLAUDIA I. MITCHELL-KERNAN**
Vice Chancellor, Academic Affairs and Dean, Graduate
Division, University of California, Los Angeles
- DR. ROBERT C. RICHARDSON**
Vice Provost for Research and Professor of Physics,
Cornell University
- DR. VERA C. RUBIN**
Staff Member, Astronomy, Department of Terrestrial
Magnetism, Carnegie Institution of Washington,
Washington, DC
- DR. MAXINE L. SAVITZ**
General Manager, Technology Partnerships, Honeywell,
Torrance, CA
- DR. LUIS SEQUEIRA**
J. C. Walker Professor Emeritus, Departments of Bacteriology
and Plant Pathology, University of Wisconsin, Madison
- DR. ROBERT M. SOLOW**
Institute Professor Emeritus, Department of Economics,
Massachusetts Institute of Technology
- DR. BOB H. SUZUKI**
President, California State Polytechnic University, Pomona
- DR. RICHARD A. TAPIA**
Noah Harding Professor of Computational & Applied
Mathematics, Rice University
- DR. CHANG-LIN TIEN**
NEC Distinguished Professor of Engineering, Department of
Mechanical Engineering, University of California, Berkeley
- DR. WARREN M. WASHINGTON**
Senior Scientist and Head, Climate Change Research Section,
National Center for Atmospheric Research (NCAR)
- DR. JOHN A. WHITE, JR.**
Chancellor, University of Arkansas, Fayetteville
- DR. RITA R. COLWELL**
Member Ex Officio and Chair, Executive Committee, Director,
National Science Foundation
- DR. MARTA CEHESKY**
Executive Officer

National Science Board Subcommittee on Science & Engineering Indicators – 2000

Claudia I. Mitchell-Kernan, Chair
John A. Armstrong
Robert M. Solow
Richard A. Tapia
John A. White, Jr.

Bob H. Suzuki, Ex Officio, Chair, Committee on Education and Human Resources

Daryl E. Chubin, NSB Staff Liaison
Mary F. Poats, Executive Secretary
Bennett I. Bertenthal, NSF Liaison
Wanda E. Ward, NSF Liaison

SCIENCE & ENGINEERING INDICATORS 2000

Volume 1

NSB NATIONAL SCIENCE BOARD

Recommended Citation

National Science Board, *Science & Engineering Indicators – 2000*. Arlington, VA:
National Science Foundation, 2000 (NSB-00-1)

National Science Board

Letter of Transmittal

NATIONAL SCIENCE BOARD
4201 Wilson Boulevard
ARLINGTON, VIRGINIA 22230

January 13, 2000

The Honorable William J. Clinton
The President of the United States
The White House
Washington, DC 20500

Dear Mr. President:

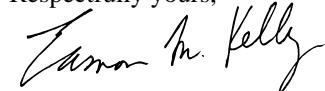
It is my honor to transmit to you, and through you to the Congress, the fourteenth in the series of biennial Science Indicators reports, *Science and Engineering Indicators–2000*. The National Science Board submits this report in accordance with Sec. 4(j)(1) of the National Science Foundation Act of 1950, as amended.

The Science Indicators series was designed to provide a broad base of quantitative information about U.S. science, engineering, and technology for use by public and private policymakers. In honor of the 50th anniversary of the National Science Board and the National Science Foundation, the Board decided to develop a special historical theme for *S&E Indicators–2000*. The report reflects on the conditions that characterized U.S. science and engineering 50 years ago as compared to the current state of the Nation's S&E enterprise.

The report enclosed contains analyses of key trends that illuminate the scope, quality, and vitality of research and education in the Nation and in an international context. In addition to a special history chapter, the report presents trends in U.S. and international R&D funds and alliances, on the S&E workforce, on science and mathematics education from the elementary level through graduate school and beyond, and on public attitudes and understanding of science and engineering. *S&E Indicators–2000* also devotes a chapter to the significance of information technologies for science and the daily lives of our citizens in schools, the workplace, home, and community.

I hope that you, your Administration, and the Congress will find the new quantitative information and analysis in the report useful and timely for informing thinking and planning on national priorities, policies, and programs in science and technology.

Respectfully yours,



Eamon M. Kelly
Chairman

Acknowledgments

With this report the National Science Board recognizes one of the most faithful readers, supporters, and critics of science and engineering, Congressman George E. Brown, Jr., who died in 1999. Congressman Brown was a friend of science and an extraordinary leader whose distinguished career in public service for three decades as a member of the U.S. House of Representatives enlightened science and technology policy.

The National Science Board extends its appreciation to the staff of the National Science Foundation for preparing this report. Organizational responsibility for the volume was assigned to the Directorate for Social, Behavioral and Economic Sciences, Bennett I. Bertenthal, former Assistant Director, and Wanda E. Ward, Acting Assistant Director. Primary responsibility for the production of the volume was assigned to the Science and Engineering Indicators Program, under the direction of Jennifer Sue Bond of the Division of Science Resources Studies (SRS); Lynda Carlson, Division Director; Mary J. Frase, Deputy Division Director; and Jeanne E. Griffith, former Division Director. The Directorate for Education and Human Resources (EHR), Luther S. Williams, former Assistant Director, and Judith S. Sunley, Interim Assistant Director, also contributed to portions of the report.

The primary authors of the manuscript were:

- Chapter 1: William A. Blanpied, INT & Jennifer Sue Bond, SRS
- Chapter 2: Steven Payson and John E. Jankowski, Jr., SRS
- Chapter 3: R. Keith Wilkinson, SRS, and Mark C. Regets, SRS
- Chapter 4: Jean M. Johnson, SRS
- Chapter 5: Larry E. Suter, EHR, and Patricia Butler, Westat, under contract to SRS
- Chapter 6: Rolf Lehming, SRS, and Alan Rapoport, SRS
- Chapter 7: Lawrence M. Rausch, SRS
- Chapter 8: Melissa Pollak, SRS
- Chapter 9: David Cheney and Maria Papadakis, SRI International, under contract to SRS

Jennifer Sue Bond, Melissa Pollak, Jean M. Johnson and Thomas M. Smith directed the physical production of the volume; Derek L. Hill, SRS, Deborah A. Collins, SRS, and David Rosenblum, SRS Intern, made substantive and statistical contributions; Vellamo Lahti, SRS, provided secretarial support; and Martha James, SRS, provided administrative assistance. Additional valuable assistance was received from the contributors and reviewers listed in Appendix A. The entire SRS staff generously provided both data and expertise.

Overall editing and coordination of the report was performed by Westat and associates (listed in Appendix B). Eileen Kessler and the staff of OmniDigital Studio, Inc., provided desktop publishing and composition services. Anne M. Houghton, SRS Publications Manager, managed the editing and composition contracts and provided guidance for the production of the report. Leland Scott of the NSF Publication Services Section managed the printing process and James Caras designed the cover. John Gawalt, SRS, was responsible for making this publication available on the World Wide Web (<http://www.nsf.gov/sbe/srs/stats.htm>). Web design, programming, and HTML coding were performed by Debbie Fleming, Andy Black, De Vo, Marjorie Silvernail, Kathy Barquin, and Jennifer Nowak of Compuware Corporation.

NSF's Office of Legislative and Public Affairs (OLPA), under the guidance of Julia A. Moore, Director, and Michael C. Sieverts, Acting Director, provided media and Congressional liaison support for the report. Special thanks go to Mary E. Hanson and Bill Noxon for media support and Joel M. Widder, Deputy Director, David Stonner, and Shirley Day for Congressional relations support.

Contents

Introduction	xiv
Chapter 1. Science and Technology in Times of Transition: the 1940s and 1990s	1-1
Introduction	1-3
Chapter Background	1-3
Chapter Organization	1-3
Highlights of the First Time of Transition: 1945–51	1-4
Emergence of a Concept	1-4
Congressional Initiatives	1-5
Administration Actions	1-5
Impacts of the Korean War	1-5
Investments	1-6
Early Visions/Key Policy Documents	1-7
<i>Science—The Endless Frontier</i> (1944–45)	1-7
<i>Science and Public Policy</i> (1946–47)	1-12
Themes and Issues	1-13
Monitoring the Condition of the Science and Engineering Enterprise	1-15
“A Program for the National Science Foundation”	1-15
Congressional and Presidential Directives	1-16
<i>Science Indicators – 1972</i> , et seq.	1-17
Presidential Statements	1-18
Harry S Truman, 1948	1-18
Major Presidential Science Policy Initiatives	1-19
William J. Clinton, 1998	1-20
Current Visions/Key Policy Documents	1-21
<i>Science in the National Interest</i> (1994)	1-21
<i>Unlocking Our Future</i> (1998)	1-22
Themes and Issues	1-23
<i>Congressional Science Policy Hearings and Studies</i>	1-24
Advances in Science and Engineering	1-27
The View by <i>Indicators</i>	1-27
Contributions from the Past and Toward the Future	1-28
The Importance of Human Resource Development: The NSF Class of 1952	1-29
Enduring Themes: Continuity and Change	1-32
Support and Performance of R&D	1-32
Centrality of the University System	1-34
Human Resources for Science and Engineering	1-35
Significance of Industrial R&D	1-36
The Federal Role	1-37
International Considerations	1-38
Public Attitudes and Understanding of Science and Technology	1-39
Impacts of Information Technology	1-39
Current Emerging Themes	1-39
Selected Bibliography	1-40
Chapter 2. U.S. and International Research and Development: Funds and Alliances	2-1
Highlights	2-3
Introduction	2-6
Chapter Overview	2-6
Chapter Organization	2-6
Economic Measures of R&D	2-7
Latest Developments in U.S. National R&D	2-7
R&D Growth Trends	2-7

Trends in Financial Support for R&D	2-9
Federal Support by National Objective	2-9
<i>21st Century Research Fund and Earlier Concepts</i>	2-11
R&D by Federal Agency	2-12
Federal Support to Academia	2-13
<i>GPRA and Federal Support for R&D</i>	2-14
Federal Funding to Other Sectors	2-15
Federal Support for Small Business R&D	2-16
<i>FY 1998 is Final Year for Tracking of Independent Research and Development Defense Spending</i>	2-17
U.S. Federal and State R&D Tax Credits	2-18
State Government Support for R&D	2-20
Historical Trends in Non-Federal Support	2-21
Trends in R&D Performance	2-21
U.S. R&D/GDP Ratio	2-21
Rates of Growth Among Sectors	2-22
Federal R&D Performance	2-23
Industrial R&D Performance	2-23
Recent Growth in Industrial R&D	2-23
R&D in Manufacturing Versus Nonmanufacturing Industries	2-23
Top 20 U.S. Corporations in R&D Spending	2-25
R&D Intensity	2-27
<i>Does Industry Under-Invest in R&D?</i>	2-27
Performance by Geographic Location, Character of Work, and Field of Science	2-28
R&D by Geographic Location	2-28
Trends in National R&D by Character of Work	2-29
<i>Definitions</i>	2-30
Federal Obligations for Research, by Field	2-32
<i>R&D Continues to Fare Well Despite Fiscal Austerity</i>	2-33
Cross-Sector Field-of-Science Classification Analysis	2-34
R&D in Chemistry, Life Sciences, and Information Technology	2-35
Inter-Sector and Intra-Sector Domestic Partnerships and Alliances	2-36
Economic Considerations Underlying R&D Partnerships	2-36
Federal Technology Transfer Programs	2-37
<i>Principal Federal Legislation Related to Cooperative Technology Programs</i>	2-37
Differences in Motivations and Goals of CRADA Participants	2-38
Scientific and Technological Conditions Underlying R&D Partnerships	2-39
Industrial R&D Consortia	2-39
International Comparisons of National R&D Trends	2-40
Absolute Levels in Total R&D Expenditures	2-40
<i>Advanced Technology Program Funding Slows</i>	2-41
Distribution of Nondefense R&D Expenditures	2-43
<i>Purchasing Power Parities: Preferred Exchange Rates for Converting International R&D Data</i>	2-43
Trends in Total R&D/GDP Ratios	2-44
Nondefense R&D/GDP Ratios	2-46
Emerging Countries' R&D Investments	2-47
R&D in the Russian Federation in Transition	2-47
International R&D by Performer, Source, and Character of Work	2-48
Performing Sectors	2-48
Sources of Funds	2-48
Character of R&D Effort	2-50
International Comparisons of Government R&D Priorities	2-50
Funding Priorities by National Objective	2-50
International Nondefense Functions	2-51
<i>Accounting for Defense R&D: Gap Between Performer- and Source-Reported Expenditures</i>	2-52
International Comparisons of Government R&D Tax Policies	2-54
International Public- and Private-Sector R&D and Technology Cooperation	2-54
Public-Sector Collaboration	2-54
U.S. Government's Use of International S&T Agreements	2-54

Private-Sector Collaboration	2-56
International Strategic Technology Alliances	2-56
International Industrial R&D Investment Growth	2-57
U.S. and Foreign Industrial R&D Expenditure Balance	2-59
Trends in U.S. Industry's Overseas R&D	2-59
Sector Focus of Overseas R&D Activity	2-60
Country Location of U.S. Overseas R&D Activity	2-61
U.S. Industry's Overseas R&D Facilities	2-63
Foreign R&D in the United States	2-64
Country Sources of Industrial R&D	2-64
Industry Focus of Foreign R&D	2-65
U.S. Research Facilities of Foreign Firms	2-65
Selected Bibliography	2-67
Chapter 3. Science and Engineering Workforce	3-1
Highlights	3-2
Introduction	3-3
Selected Characteristics of the S&E Workforce	3-3
How Large is the U.S. S&E Workforce?	3-3
Basic Characteristics	3-3
Relationship Between Education and Occupation	3-3
<i>Who is a Scientist or Engineer?</i>	3-4
Sector of Employment	3-7
<i>How Important is Temporary Work for Scientists and Engineers?</i>	3-8
Salaries	3-8
Who Performs R&D?	3-8
Women and Minorities in S&E	3-10
Women Scientists and Engineers	3-10
Racial or Ethnic Minority Scientists and Engineers	3-12
Labor Market Conditions for Recent S&E Degree-Holders	3-13
Bachelor's and Master's Degree Recipients	3-13
Recent Doctoral Degree Recipients	3-14
<i>Data on Recent Ph.D. Recipients in Professional Society Data</i>	<i>3-16</i>
Age and Retirement	3-22
Projected Demand for S&E Workers	3-24
Foreign-Born Scientists and Engineers in the United States	3-25
<i>What Fields Did Computer Workers Get Degrees In?</i>	<i>3-25</i>
<i>Foreign Scientists and Engineers on Temporary Work Visas</i>	<i>3-27</i>
Stay Rates of Temporary Ph.D. Recipients from U.S. Schools	3-28
International R&D Employment	3-28
Selected Bibliography	3-29
Chapter 4. Higher Education in Science and Engineering	4-1
Highlights	4-2
Introduction	4-5
Chapter Overview	4-5
Chapter Organization	4-5
Characteristics of U.S. Higher Education Institutions	4-5
Expansion of Institutions	4-5
Long-Term Trends in Enrollment in U.S. Higher Education	4-6
<i>Carnegie Classification of Institutions</i>	<i>4-8</i>
S&E Degree Production by Type of Institution	4-8
Baccalaureate Origins of Ph.D.s	4-10
Demographics and U.S. Higher Education	4-11
Undergraduate S&E Students and Degrees in the United States	4-11
Characteristics of American College Freshmen	4-11
Engineering Enrollment	4-13
Associate's Degrees	4-13

Bachelor's Degrees	4-15
<i>Institution-Wide Reform</i>	4-16
International Comparison of First University Degrees in S&E	4-16
Diffusion of Higher Education in S&E Fields	4-16
Growth Rates in S&E Fields	4-17
Comparison of Proportion of Degrees in S&E and non-S&E Fields Across Countries	4-18
Participation Rates in University Degrees and S&E Degrees	4-19
Graduate S&E Students and Degrees in the United States	4-20
Trends in Graduate Enrollment	4-20
Master's Degrees	4-20
Doctoral Degrees	4-20
International Comparison of Doctoral Degrees in S&E	4-21
Trends in Doctoral Degrees—Europe and the United States	4-22
Trends in Doctoral Degrees—Asia	4-23
<i>Graduate Reforms in Europe, Asia, and Latin America</i>	4-24
Diversity Patterns in S&E Enrollment and Degrees in the United States	4-26
Enrollment in Undergraduate Programs, by Race/Ethnicity and Sex	4-26
Enrollment in Engineering, by Race/Ethnicity and Sex	4-26
Persistence Toward a Bachelor's Degree, by Sex and Race/Ethnicity	4-26
Associate's Degrees	4-28
Bachelor's Degrees	4-28
Graduate Enrollment, by Citizenship, Race/Ethnicity, and Sex	4-31
Master's Degrees	4-31
Doctoral Degrees	4-32
Postdoctoral Appointments	4-36
International Dimension of U.S. Higher Education Faculty	4-37
Conclusion	4-38
Selected Bibliography	4-39
Chapter 5. Elementary and Secondary Education	5-1
Highlights	5-3
Introduction	5-5
Chapter Organization and Sources of Data	5-5
Educational Reform from the 1950s to the Present	5-5
<i>View of Mathematics and Science Education in Elementary Schools in 1947</i>	5-6
<i>National Science Foundation Support of Post-Sputnik Reforms in Science and Mathematics Education</i>	5-7
<i>Systemic Reform: Complex Solutions to Complex Problems</i>	5-8
The Social Context of Education	5-8
<i>The National Education Goals</i>	5-9
Schooling and School Choice in the 21st Century	5-11
Student Achievement	5-12
Trends in National Achievement	5-12
<i>Proficiency Levels Used in NAEP Science and Mathematics Trends Assessments</i>	5-12
Elementary and Middle School Science and Mathematics	5-12
High School Achievement	5-13
Achievement Trends by Demographic Group	5-14
Summary of NAEP Performance	5-17
U.S. Achievement in an International Context	5-17
Achievement of Fourth and Eighth Grade American Students	5-17
Achievement of Students in the Final Year of Secondary School	5-18
Achievement on General Knowledge Assessments	5-18
Achievement of Advanced Students	5-18
Performance of the Highest Achievers	5-19
Performance of Students from the G-7 Nations	5-21
Summary of TIMSS Findings	5-22
Science and Mathematics Coursework	5-22

<i>First in the World Consortium Near the Top</i>	5-23
Curriculum and Instruction	5-26
Instructional Time	5-26
Content: Curriculum and Textbooks	5-27
Instructional Practice	5-29
Technology	5-30
<i>AAAS Project</i>	5-31
Teachers and Teaching	5-34
Teacher Qualifications	5-34
Degrees Earned	5-34
Undergraduate Major	5-35
Experience	5-35
Certification	5-35
In- and Out-of-Field Teaching Assignments	5-36
The Teaching Profession in the 21st Century	5-36
Conclusion	5-37
Selected Bibliography	5-38
Chapter 6. Academic Research and Development: Financial and Personnel Resources, Support for Graduate Education, and Outputs	6-1
Highlights	6-2
Introduction	6-5
Chapter Background	6-5
Chapter Organization	6-5
Financial Resources for Academic R&D	6-6
Academic R&D in the National R&D Enterprise	6-7
Major Funding Sources	6-8
Funding by Institution Type	6-9
Distribution of R&D Funds Across Academic Institutions	6-9
Expenditures by Field and Funding Source	6-10
Federal Support of Academic R&D	6-11
<i>EPSCoR—the Experimental Program to Stimulate Competitive Research</i>	6-14
Academic R&D Facilities and Equipment	6-15
Academic Doctoral Scientists and Engineers	6-19
The Academic Doctoral Science and Engineering Workforce	6-19
<i>Data Source</i>	6-20
Research and Teaching Activities	6-27
Federal Support of Academic Researchers	6-28
Financial Support for S&E Graduate Education	6-28
<i>Definitions and Terminology</i>	6-29
Support of S&E Graduate Students and S&E Doctorate Recipients	6-29
<i>Graduate Modes of Financial Support and Time to Degree</i>	6-31
<i>Multiple Modes of Financial Support for S&E Ph.D.s</i>	6-33
Research Assistantships as a Primary Mechanism of Support	6-34
<i>Relationship Between Support Modes and Early Employment of Recent S&E Ph.D.s</i>	6-35
<i>The Debt Burden of New Science and Engineering Ph.D.s</i>	6-40
Outputs of Scientific and Engineering Research: Articles and Patents	6-42
<i>Data Sources for Article Outputs</i>	6-42
U.S. Articles: Counts, Collaboration, and Citations	6-43
Linkages Among Disciplines	6-45
International Article Production: Counts, Collaboration, and Citations	6-45
Citations on U.S. Patents to the Scientific and Technical Literature	6-53
Academic Patenting: Patent Awards, Licenses, Startups, and Revenue	6-55

Conclusion	6-58
Selected Bibliography	6-59
Chapter 7. Industry, Technology, and the Global Marketplace 7-1	
Highlights	7-2
Introduction	7-4
Chapter Background	7-4
Chapter Organization	7-4
U.S. Technology in the Marketplace	7-4
The Importance of High-Technology Industries	7-6
<i>International Activity in High-Technology Service Industries</i>	7-6
Share of World Markets	7-7
Global Competitiveness of Individual Industries	7-8
Exports by High-Technology Industries	7-9
Competition in the Home Market	7-10
U.S. Trade Balance	7-11
U.S. Royalties and Fees Generated from Trade in Intellectual Property	7-14
International Trends in Industrial R&D	7-16
Overall Trends	7-17
R&D Performance by Industry	7-17
<i>Economists Estimate Rates of Return to Private R&D Investment</i>	7-18
Patented Inventions	7-20
U.S. Patenting	7-20
Patents Granted to U.S. Inventors	7-20
<i>Top Patenting Corporations</i>	7-21
Patents Granted to Foreign Inventors	7-21
Technical Fields Favored by Foreign Inventors	7-22
Patenting Outside the United States	7-23
Venture Capital and High-Technology Enterprise	7-23
Venture Capital Commitments and Disbursements	7-25
Venture Capital Investments by Stage of Financing	7-26
Summary: Assessment of U.S. Technological Competitiveness	7-27
Selected Bibliography	7-27
Chapter 8. Science and Technology: Public Attitudes and Public Understanding 8-1	
Highlights	8-2
Introduction	8-3
Chapter Overview	8-3
Chapter Organization	8-3
Interest in—and Knowledge about—Science and Technology	8-3
Public Interest in Science and Technology and Other Issues	8-4
The Public’s Self-Assessed Level of Knowledge about Science and Technology and Other Issues	8-7
The “Attentive” Public for Science and Technology Policy	8-7
<i>The Most Closely Followed Science-Related News Stories: 1986–99</i>	8-8
Public Understanding of Science and Technology	8-9
Public Attitudes Toward Science and Technology	8-13
<i>Attitudes of Scientists, Legislators, and the Public Toward Science and Technology</i>	8-14
The Promise of Science—and Reservations	8-15
Public Attitudes Toward the Funding of Scientific Research by the Federal Government	8-15
<i>Americans Give High Marks to Government Investment in R&D</i>	8-17
Public Confidence in the People Running Various Institutions	8-17
Perceptions of Scientific Research	8-18
Perceptions of Nuclear Power	8-19
Perceptions of Genetic Engineering	8-19
<i>Public Attitudes Toward Biotechnology</i>	8-20
Perceptions of Space Exploration	8-21
Perceptions of the Use of Animals in Scientific Research	8-22

Use of Computers and Computer Technology in the United States	8-23
The Relationship Between Science and the Media: Communicating with the Public	8-25
<i>Where Americans Get Information about Science and Technology</i>	8-26
What Are the Problems?	8-26
<i>Y2K Awareness and Concerns</i>	8-27
What Should Be Done To Improve the Relationship?	8-30
Belief in the Paranormal or Pseudoscience	8-31
Belief in the Paranormal: How Common Is It?	8-31
Do the Media Have a Role in Fostering Belief in the Paranormal?	8-32
What Is Being Done To Present the Other Side?	8-33
Conclusion	8-33
Selected Bibliography	8-34
 Chapter 9. Significance of Information Technologies	9-1
Highlights	9-3
Introduction	9-4
Chapter Overview	9-4
IT Data and Measurement	9-4
Information Technologies	9-5
<i>Moore's Law</i>	9-6
Information Technology Over the Past 50 Years	9-6
<i>Excerpts from "As We May Think"</i>	9-8
<i>IT Timeline</i>	9-9
<i>Growth of the Internet</i>	9-10
IT and the Economy	9-11
Use of IT in Business	9-11
<i>What is Electronic Commerce?</i>	9-12
International Context of Electronic Commerce	9-13
Effects of IT on Productivity and Economic Growth	9-14
Effects on Composition of the Economy	9-16
<i>IT and the Banking Industry</i>	9-17
<i>IT and the Trucking Industry</i>	9-18
Effects on Income and Employment	9-18
IT Workforce	9-20
IT and Education	9-21
IT in the Classroom	9-21
Distance Education	9-25
<i>Innovative Education Projects</i>	9-25
IT, Research, and Knowledge Creation	9-27
Scholarly Communication	9-27
Digital Libraries	9-30
Effects of IT on Research	9-31
<i>Growth of the World Wide Web</i>	9-32
Collaboratories	9-34
IT and the Citizen	9-34
IT in the Home	9-34
<i>IT and Disabilities</i>	9-38
Information Technology, Government, and Citizens	9-40
Conclusion	9-41
<i>Potential Information Technology Indices</i>	9-42
Selected Bibliography	9-42
 Appendix A. Contributors and Reviewers	A-1
 Appendix B. Index	B-3